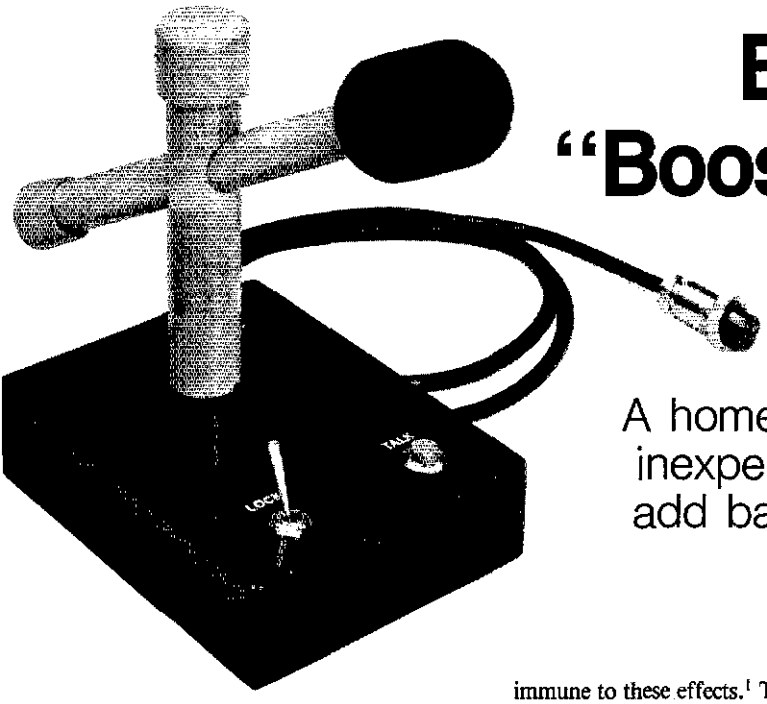

# Build a Low-Cost "Booster" Microphone

A home-constructed desk microphone is inexpensive and easy to build. You can add bass and treble boost by mounting the electronics in the base.

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Is your voice, like mine, too bassy for effective communications? Or perhaps you have a voice that has lots of highs, but is sorely lacking in low-frequency components. In either event, it is productive to include a bass and treble boost circuit in the transmitter audio channel, or in the home-station mike stand. This article details a mike-stand circuit and shows how to build an entire desk mike from readily available materials.

### The Nature of Human Voices and Microphones

Some commercial mikes aren't suitable for communication-quality audio. They may be too bassy or they may accentuate only the high-frequency voice sounds. The audio channel in your transmitter may not be designed to amplify, equally, the desired voice range from, say, 300 to 2500 Hz. This is the range that has long been considered the ideal for voice communications in terms of effectively breaking through interference and noise during weak-signal QSOs.

A characteristically high or low voice can render an otherwise Q5 signal ineffective when the going gets rough. It is useful, therefore, to have a bass and treble boost circuit in the mike line to roll off or accentuate the lows or highs in our voice signals. A circuit of this type is also useful for mikes with limited frequency response, or if the mike amplifier in the transmitter is suffering from inadequate frequency response. The boost circuits can provide "presence" for your voice signal, and this may enhance the readability of your signal without degrading the speech quality.

### The Boost Circuit

Fig 1 shows the circuit I use in my home-made mike. An important feature is its RF suppression. A number of amplified mikes are subject to RFI and require the addition of RF chokes and bypass capacitors to make them immune to these effects.[1] The Fig 1 circuit includes these devices (C2, C4, C13, C15, C16 and RFC1). These suppressors help prevent stray RF energy from disrupting the performance of the mike amplifier and booster. They also aid in keeping stray RF energy (picked up by the mike cord) from entering the mike amplifier in the transmitter. These components may be added to commercial mikes if you have a problem with RFI in the audio circuit.

Q1 is an audio preamplifier that is biased for low current. This ensures long life for BT1. Total current drain for the circuit in Fig 1 is 2.25 mA, inclusive of the mike-element current (1 mA). A 9-V transistor-radio battery should last almost as long as its normal shelf life. A low-cost Radio Shack® electret mike element is used.

Overall maximum gain for the Fig 1 circuit is 28 dB. Although this is far too much gain for most mikes and rigs, I provided the gain for dealing with low-output mikes. The output level of the system can be set by adjusting R15. I also wanted plenty of available gain to permit the circuit to be integrated into home-made SSB exciters. It can be used in place of a conventional mike amplifier circuit if the boost feature is desired. In many instances, the electret mike element will yield ample output for direct connection to your transceiver. You may want to build this mike and eliminate the electronics if you don't care for the boost feature.

The boost circuit in the center of Fig 1 (R7, R11 and related components) has been around for decades. I used it in hi-fi vacuum-tube audio amplifiers many years ago. It is still being used in some modern stereo amplifiers that don't include graphic equalizers. The potentiometers have no effect at the audio midrange (roughly 500 to 1000 Hz). Fig 2 shows how the circuit boosts frequencies above and below the flat range.

U1 provides additional audio gain and is a part of the boost circuit. A word of caution here: I learned that BIFET op amps, such as the TL080, tend to self-oscillate in this circuit. Generic 741 op amps (several brands tried) work fine—and there is no sign of instability, provided C15 is used from pin 3 to ground.

An electret mike needs an operating voltage (4.5 V is considered optimum), although any dc voltage from 1.5 to 10 is considered satisfactory. R1 of Fig 1 sets the mike impedance at 1 kΩ and allows the required dc voltage to reach the mike. R1 isolates the audio energy from the dc supply line.

If you desire less overall channel gain, you can replace C3 with a lower value. However, the lower the C3 value, the less gain there will be at low frequencies. This is a matter of choice, but a value as low as 0.1 μF may be used when reducing the stage gain. A good compromise value is 1 μF if you have a bassy voice and do not need maximum bass boost.

C4 has the opposite effect of C3—it rolls off the high frequencies. Its value may be chosen to suit your specific needs. The larger the C4 value, the greater the high-frequency attenuation. C1 and C12 may be reduced in capacitance if you want to restrict the passage of very-low-frequency voice energy. Values as low as 0.1 μF may be used in those parts of the circuit.

S2 (a momentary switch) and S3 (a toggle switch) are mounted on the base for PTT or carrier-lock use. They are in the OFF position for VOX operation. If you don't like the small button on the PTT momentary switch, consider using epoxy to glue a plastic poker chip or similar object to the switch button.

### Construction Notes

When you look at the photograph, you may judge this project to be an ugly duckling. It definitely lacks the class imparted by a modern commercial desk mike, but it's inexpensive. The boom is made from ½-inch PVC pipe. The vertical post is fashioned from ¾-inch PVC pipe. The boom portion is 6½ inches

[1]Notes appear on page 21.

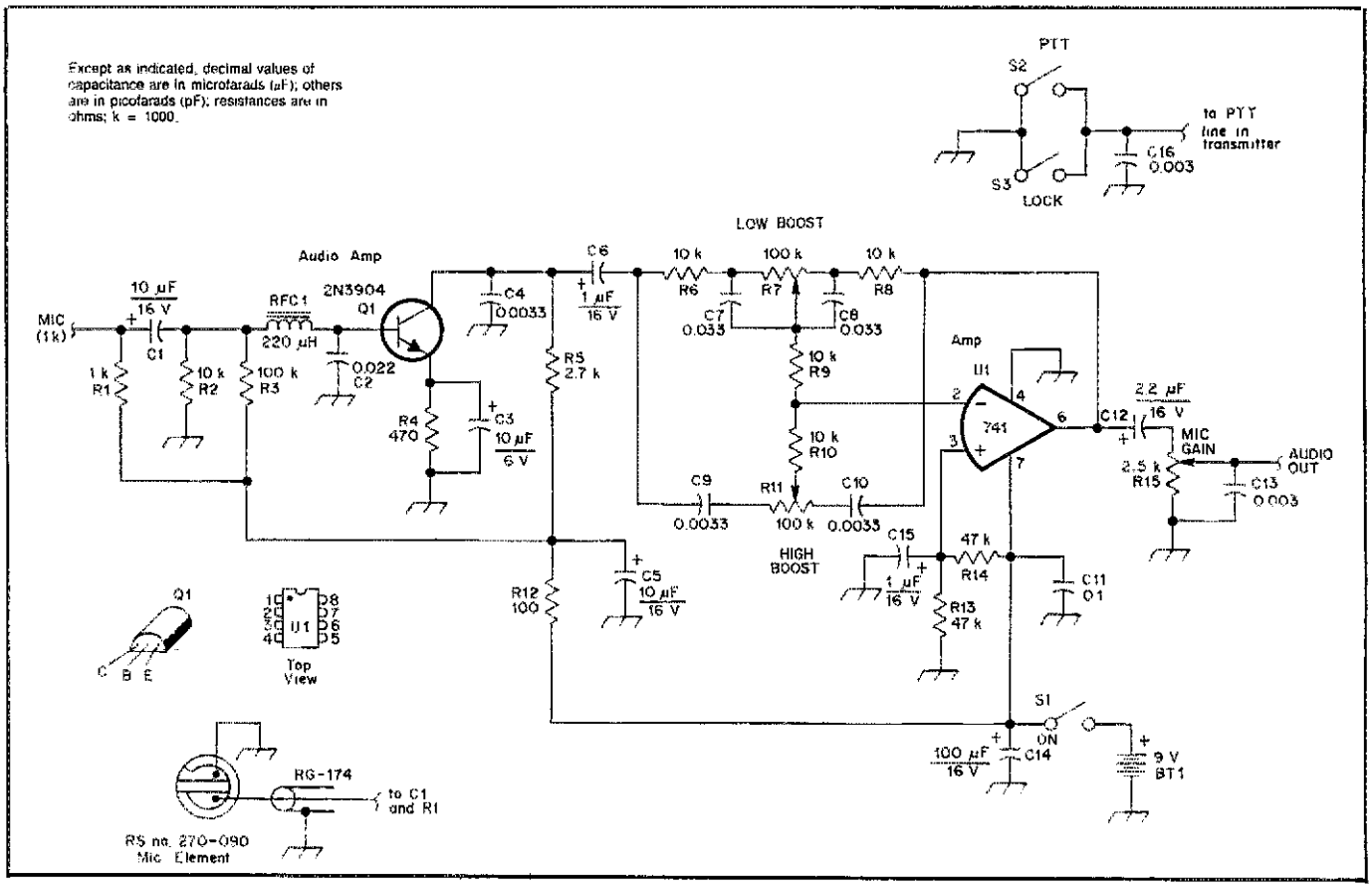


Fig 1—Schematic diagram of the mike amplifier/booster. Capacitors are disc ceramic unless otherwise noted. Polarized capacitors are electrolytic or tantalum. Fixed-value resistors are ¼-W carbon composition.

BT1—Standard 9-V transistor-radio battery.
C7-C10, incl—Mylar® or disc ceramic (match values within 5%).
R7, R9, R15—Miniature PC-mount control with triangular lead layout.
RFC1—Miniature RF choke, 220 μH to 1 mH (value not critical). Do not substitute a ferrite bead.
S1, S3—Miniature SPST toggle.
S2—Momentary push-button switch, normally open.
U1—8-pin DIP 741 op amp.

long, including the pipe cap at the back end. The vertical post is 5½ inches long, inclusive of the pipe cap.

I made the base from pieces of single-clad PC board. The dimensions (HWD) are 1-3/8 × 4 × 5-1/8 inches. The PC sections are soldered at the seams (copper surfaces inside the box). A piece of PC-board stock serves as the bottom plate for the base. The circuit board for Fig 1, BT1 and a 3/4-inch PVC pipe cap are affixed to the bottom plate (Fig 3). A 7/8-inch hole is bored in the top surface of the base to coincide axially with the 3/4-inch pipe cap inside the box. The vertical post for the mike fits snugly into the pipe cap.

I installed the electret element in one end of the PVC boom. The element needed to be wrapped with a few turns of masking tape to ensure a snug fit. It is held in place also by a short no. 4-40 screw that fits in a threaded hole at the mike end of the boom. RG-174 coaxial cable is used between the mike element and the PC board in the base. The cable is passed through a hole in the boom (at the junction of the boom and the vertical post). Another hole is bored in the vertical post, just below the top surface of the base. This allows the RG-174 cable to be routed to the PC board above the pipe cap.

I used a discarded foam blast filter from a tape-recorder mike as a mike cover. You may substitute a 1/2-inch PVC pipe cap, in which many 1/8-inch holes have been drilled (into the flat end). Or, you can fashion a cover from a piece of flexible foam material. Be sure to locate the electret element flush with the open end of the PVC pipe. If it is recessed, it will affect the audio quality.

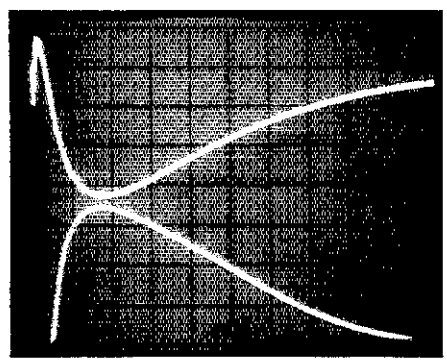

Fig 2—Response curves of the microphone amplifier at maximum and minimum boost settings. Vertical divisions are 2 dB each for a range of 16 dB. Horizontal divisions are 500 Hz each for a range of 0 to 5000 kHz.

My battery holder, soldered to the base plate, is made from some strip brass I had on hand. The top section of the box holds the battery in place when the unit is assembled. Make the various interconnect leads long enough so the base plate can lie alongside the top portion of the box. This will make the final wiring much easier. Terminal strips may be used as tie points for the wiring.

I painted the boom and post with gray automotive primer after sanding the PVC pipe to roughen it. Clear lacquer was added after the primer had dried for 24 hours. The base unit was painted with gray primer, then with black spray paint. Decals, followed by a coating of clear lacquer, were added. To ensure that the paint adheres, be sure to first sandpaper the noncopper sides of the base unit.

The diagonal hole in the vertical post is a bit tricky to drill. I placed the 3/4-inch pipe in my drill-press vise at the desired angle. I drilled first with a 1/8-inch bit, then redrilled the hole with successively larger bits until I had a 1/2-inch hole. A round file was then used to shape the hole for a snug fit between the boom pipe and the vertical one. A drop of PVC cement will lock the pieces together; likewise for the pipe cap at the back end of the boom.

The circuit of Fig 1 fits on a PC board that measures 1½ × 3¼ inches. Drilled and plated

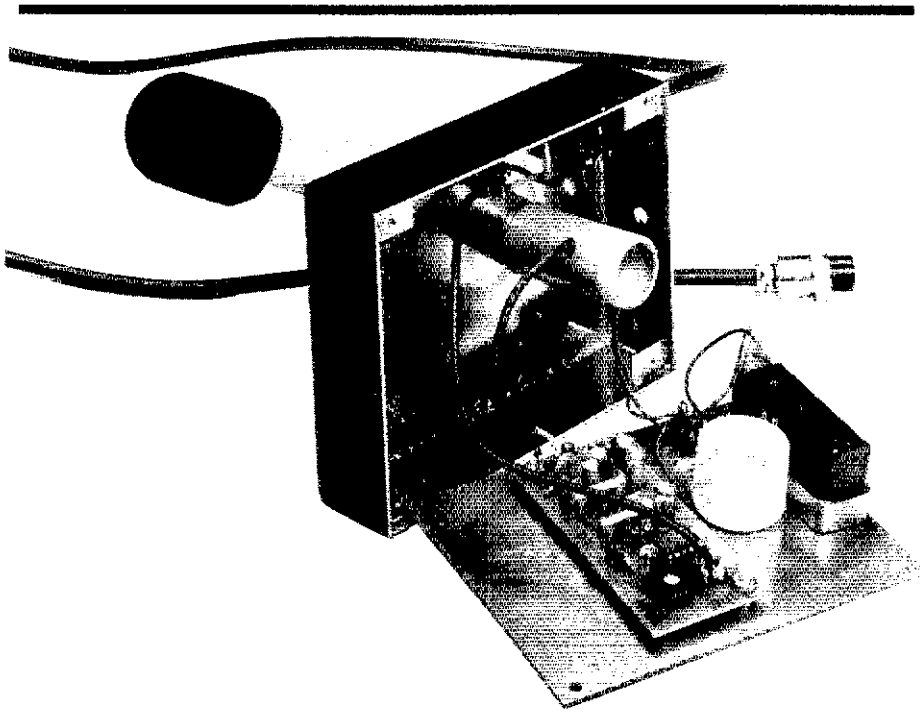

Fig 3—Internal view of the mike. The PC board is elevated above the base plate by means of short metal spacers. Shielded leads (RG-174) are used for the audio lines. The shield braid is grounded at each end of these leads. Shielded two-conductor mike cord is recommended between the mike and the transmitter.

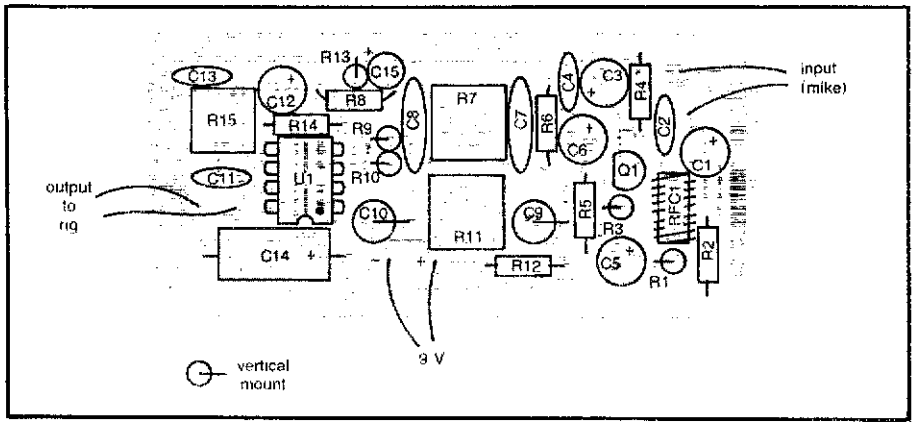


Fig 4—Parts-placement guide for the PC board. Parts are placed on the nonfoil side of the board; the shaded area represents an X-ray view of the copper pattern. Component outlines are not necessarily representative of the shapes of the actual parts used. BT1, C16, S1, S2 and S3 are external to the board.

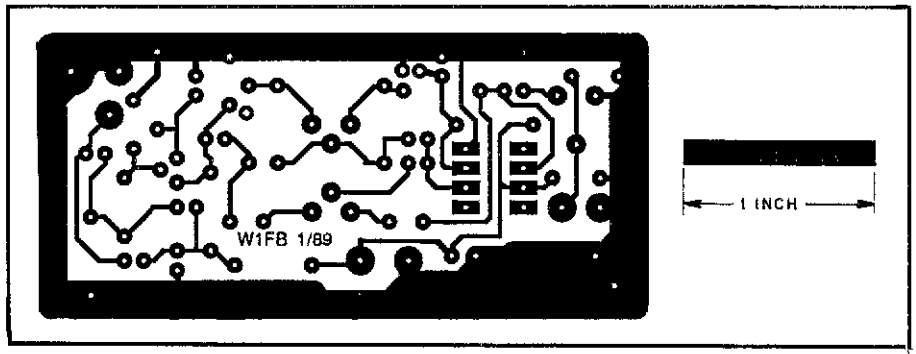


Fig 5—Circuit-board etching pattern, shown full size from the etched side of the board. Black areas represent unetched copper foil.

boards are available for this project.[2] Fig 4 is a parts-placement guide for the board, and Fig 5 is the full-size etching pattern.

Perhaps you have a commercially made mike that needs a bit of bass or treble boost. If so, consider installing the Fig 1 circuit in the base enclosure. If there is insufficient room there, you can build the circuit into a small box and use it between your mike and the rig.

### Proper Adjustment

Be aware of the gain of this mike! I recommend that you adjust your rig for the correct audio level with the stock or existing nonamplified mike. Do this in accordance with the instruction manual and with on-the-air checks. Now, replace that mike with this one. Adjust R15 for the same peak meter readings you obtained with mike number 1. Do not exceed this output level. Too much audio from the mike will overdrive the input circuit of your transmitter and cause distortion. You may now experiment with the settings for R7 and R11.

Operate your rig into a dummy antenna and monitor the signal with a receiver (AGC disabled and RF gain control setting reduced). Tweak the boost controls until you feel that the audio response is suitable for your voice. Final adjustments may be carried out on the air. Try to obtain reports from amateurs who have heard you speak in person. Do not use a speech processor when you make your preliminary tests, as you won't get an accurate picture of your voice range and quality.

### Concluding Remarks

I'm pleased with the performance of my ugly duckling. I have used a commercial desk mike for years, and it has given me the punch and audio range I needed with my deep voice. During on-the-air tests, however, I have been told by friends that I sound more natural with the new mike. There is also plenty of punch. For example, Bud, W8PLC, said, "I no longer have to tune off your frequency to make you sound right." Norm, W8EEF, commented, "It's an improvement. You sound just like you do in person." I should qualify these remarks by saying that I use maximum treble boost and minimum bass boost. These tests were performed while using a Yaesu FT-102 transceiver.

I operated from 1.8 through 29 MHz at 1.5 kW PEP while checking for RFI in the mike. There was no indication of RF-related problems at any frequency within that range. I did not test the mike while using the 12-meter band.

I estimate the cost of this unit (exclusive of the PC board) at $10. A skilled scrounger should be able to duplicate this unit for as little as $5. It's a far cry from paying $75 for a store-bought mike that may not suit my voice! If you can live with the homeliness of this mike, you may want to duplicate it.

### Notes

[1]D. DeMaw, "How to Deal with Audio RFI Problems," *QST*, May 1988, pp 18-20.

[2]A circuit board for this project is available from FAR Circuits, 18N640 Field Ct, Dundee, IL 60118, tel 312-426-2431, evenings. Price (as of this writing) is $4.50 postpaid.